The Effect of Point of Care Technology on the Quality of Patient Care

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It is thought that new technologies like computers at the patient's bedside, or point of care technology (PCT) improve nursing productivity, documentation, patient satisfaction and decrease costs. Using the Health Care Technology Assessment (HCTA) framework, (safety, cost, effectiveness, social impact), a descriptive and quasi-experimental study was performed to test the effectiveness and explain the social impact of PCT. A sample of 90 patients from five nursing units in three hospitals were obtained for the study. Half of the patients had computers at their bedside. Data were collected on a hospital pretest/posttest unit and two comparison and experimental units. The main null hypothesis was: There is no difference in the quality of patient care on nursing units with and without PCT. Quality of patient care was measured by patient satisfaction and a nursing care documentation instruments. This hypothesis was rejected. While patients were generally very satisfied with their nursing care on all units, when controlling for time and the presence of the computer, patients who did not have PCT were more satisfied than patients in rooms with PCT. Furthermore, the charts of patients with PCT were less compliant to documentation standards. Conversely, a sub sample of these same patients expressed positive responses to the bedside computer and technologies in their room and this concurred with the current literature. The benefits of the technology were found to outweigh the costs of PCT from the literature review. There was not enough in the literature to draw conclusions about the safety of PCT. In summary, the quality of patient care did not improve with the implementation of PCT in this study. While patient satisfaction with nursing care was generally high, and patients were positive about bedside computer technology, future studies should focus on staff attitudes, the implementation process, the placement and types of the computers within the patient room. This study points out the need for PCT to be a part of a larger plan for patient centered care where all processes of delivery of care are directed toward the patient, not just nursing documentation.

INTRODUCTION

New technologies have not only dramatically changed nursing, but have also added to the cost of patient care. While Point of Care technology is diffusing rapidly, it has not been evaluated systematically. Technology assessment research is lacking and must be implemented to define the effects of PCT on the patient. Nursing must look at patient outcomes and define the goals for implementing an information system at the patient's bedside.

PURPOSE

The purpose of this study was to address the effects of bedside computers, or point of care technology, on the quality of patient care. The research also examined the social consequences of PCT on the patient and reviewed cost and safety implications.

SIGNIFICANCE

As bedside computer systems are being planned and installed in many hospitals, the study of this computer technology and patient responses to the technology are important to nursing practice and administration. Information on the impact will assist nurses in understanding and improving planning and implementation strategies, and selecting the best technology to improve the quality of patient care. Measuring the quality of patient care is a difficult task and at best, may be a proxy measure of technology effectiveness.

The cost and safety of new information systems technologies must also be considered. Health care administrators need to be aware of the return on investment and documented benefits of bedside systems.

Finally, the four major areas of safety, cost, effectiveness, and social impact of this new technology must be evaluated for policy decision-making (purchase, implementation) by nursing and

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hospital administration. The results of this study assist with generation of new nursing knowledge and understanding of information systems at the patient's bedside. In addition, knowledge of the impact of computers on patients will direct future research and policy.

CONCEPTUAL FRAMEWORK

The Health Care Technology Assessment (HCTA) framework was used in this study. HCTA is a comprehensive research framework used to examine health care technologies such as drugs, devices, medical, surgical and nursing procedures and systems, in order to provide information for clinical and social policy development [1]. The purpose of HCTA is to improve patient care. It was developed originally by the Office of Technology Assessment [2]. It assists in ensuring that technologies which have potential benefits with acceptable risks are made available, and the diffusion of technologies which lack effectiveness are constrained [3]. According to the Office of Technology Assessment (OTA), technologies are drugs, devices, procedures and systems [4]. Any process of examining and reporting these technologies is considered technology assessment.

Using the health care technology assessment framework of safety, effectiveness, cost/benefit, and social impact, bedside information systems or PCT were evaluated as a nursing technology. The consequences of safety, and the cost/benefit of PCT were drawn from an analysis of current literature. The social impact was assessed by patient interviews. Effectiveness was measured by two patient satisfaction questionnaires, and a chart audit.

RESEARCH QUESTIONS

This study focused on the effects of PCT on the quality of patient care. Two major research questions guided the design and procedures. The first research question was: **Does PCT improve the quality of patient care?** This question addressed two aspects of quality of patient care: patient satisfaction and documentation of care nursing given. Two measures of patient satisfaction and a chart compliance audit were used to test the hypotheses. The second question was: **What is the social impact of PCT on patients who are hospitalized?** This question addressed how patients reported they felt about PCT at the bedside and asked their opinions of how it was used by staff. Patients were interviewed to assess this information. These opinions were descriptive in nature. How patients feel about PCT may effect the outcome of their care. These social impact interviews illustrated how patient perception and comfort can be affected by computer technology.

Hypothesis

The main hypothesis, stated in the null for this study was: There is no difference in the quality of patient care on nursing units with point of care technology (PCT) and nursing units without point of care technology (no PCT).

REVIEW OF THE LITERATURE

While nurses have dramatically increased the use of technology in their practice, few studies have actually evaluated the impact of nursing technologies. Zeilstorff [5] analyzed all studies concerning evaluation of information systems for healthcare and found that there were many studies on the effects of information systems on nurses, but few on the effects on patient care. Studies did not partial out the contribution of information systems to actual clinical outcomes. In addition Staggers [6] points out the sparseness of studies and the methodological problems in published studies on the impact of information systems on nursing practice. Studies lack statistical reliability and validity for instruments.

Evaluating Point of Care Technology

Descriptive, anecdotal reports overshadow evaluation of PCT in acute care. This may be because of the newness, the variety of systems available, and the lack of a standard evaluation framework. Case studies and surveys based on discussions with hospital administrators or nurses point out potential benefits such as time savings, and increases in the quality of documentation and nursing job satisfaction. Kahl, Ivancin and Fuhrmann [7] describe the "magnet attribute (competitive advantage of a technology in recruiting and retaining health care providers)," positive impact on nursing standardization, timeliness of data availability, decreased chart bulk, and significant financial saving in a detailed study of PCT.

Knickman, Kovner, Hendrickson, and Finkler [8] explored nursing innovations to enhance nursing

practice including bedside and host systems. While the computerization had a substantial positive effect on recruitment and a smaller positive effect on nurse satisfaction, there was no significant change in patient satisfaction on the 69 units in this study. In reality, point of care technology has not been thoroughly studied from the aspect of the patient and changes in quality of care.

Health Care Technology Assessment Framework (HCTA) HCTA is a form of research and analysis which explores the impact of safety, effectiveness, cost-effectiveness and social impact on the individual and society. Literature on safety, cost, effectiveness and social impact are discussed below.

Safety This is the protection that PCT must have to be operated in a patient environment. The electrical standards and hygienic guidelines for PCT are not documented nor discussed in the literature.

Cost The delicate preservation of the balance between costs and the quality that new technology brings is an ongoing debate. The cost of new PCT can be measured by changes in unit costs, annual dollar benefit projections, pharmacy savings, and estimated return on investment (ROI) studies. Many studies attribute considerable time savings in to health providers not walking long corridors, and in decreased time for unit communication to computers. They also use estimates of reduction in agency and overtime costs and convert these into full time equivalent (FTE) nursing positions saved. Herring and Rochman [9] found the ROI in a study of three hospitals with bedside computers, to average financial payback in 24 months. Hopkins [10] studied three hospitals using a cost effectiveness analysis and found a two to over a five year recovery of capital costs. He also found that bedside terminals can be cost effective particularly when there is an interface to existing hospital information systems. Kahl, Ivancin, and Fuhrmann [11] described full time equivalent avoidance or potential reduction of 28.5 FTEs (and subsequent expense reduction) in their 567 bed facility.

Effectiveness Asking the question "Does it work?" and measuring PCT systems under average conditions indicate the effectiveness. Qualitative, subjective findings abound in the literature for the positive impacts of automation in hospital, but strong empirical evidence of the relationship between PCT and quality of patient care is lacking.

Social Impact The social impact of information systems includes the social, and political effects on the patient and providers (as computer users). Halford [12] reported that patients were curious about what the nurse was entering in the computer, but that the computer was treated like any other equipment in the room. Although there are few studies on the social impact of computers on patients, Marr [13] found positive patient perceptions with bedside computers. Blank and Bauer [14] found that physicians indicated that nurses were reporting patient changes sooner because they were spending more time with patients when they had bedside computers.

In conclusion, few empirical studies have established the influence this technology has on the quality of patient care and the social impact on the patient.

DESIGN OF THE STUDY

A descriptive and quasi-experimental study of the impact of PCT using a convenience sample of patients on five medical/surgical nursing units was conducted in three acute care hospitals in the North East U.S. A quasi-experimental design was selected because there could be no random assignment of subjects to conditions. A one unit pretest-posttest design was used to compare units before and after PCT was introduced. Two comparison/experimental units were also studied. A time block (Time 1, Time 2) was used to compare the pretest-posttest with two comparison/experimental units for statistical testing. The study included a descriptive component because open-ended patient interviews (N=21, subset of same patients) were conducted. The interview elicited the patient's perception, attitude and opinion about the computer and technology in the patient room.

Variables

The main independent variable was the presence or absence of PCT at the bedside. There was one cluster of dependent variables: effectiveness or quality of patient care as indexed by patient satisfaction with nursing care and perception of computer related/technology related nursing care, and nursing documentation compliance. The covariates were patient gender, race, age, and computer experience.

Instruments
The Patient Satisfaction Instrument (PSI) by Hinshaw and Atwood [15], adapted from Risser [16], the Patient Perceptions of Computer Related/Technology Related Care Instrument (PPCI), an author developed tool investigating the patient's perception of computer or technology in the hospital room, and the Joint Commission on Accreditation of Health Care Organizations (JCAHO) Nursing Care Standard, NC.1, 1991 were used.

Subject Sample
The selection criteria for patients includes the ability to read and speak English, hospitalization for at least 24 hours, no patient knowledge of discharge within 8 hours of interview, alert and medically capable of giving an opinion and agreement to participate in the study.

Data Analysis
Descriptive statistics, one way analysis of variance (ANOVA), two way analysis of variance (TWO WAY ANOVA) and multiple regression statistical procedures were used to explain the effect of the independent variable (PCT) on the dependent variables accounting for the variance supplied by significant covariates.

Findings
The main hypothesis was rejected. Individual units had significant differences when an ANOVA was calculated. The TWO WAY ANOVA indicated significantly lower PCT scores ($p < .05$) compared to units that did not have PCT, for all three instruments. Finally, using multiple regression, it was found that there were two significant predictors of the instrument test results: (1) patient race predicted the lower JCAHO Chart Audit scores and (2) the presence of the computer significantly lowered PPCI and PSI, and marginally lowered the JCAHO scores. When controlling for all the covariates, the absence of the computer was the largest predictor of positive patient satisfaction scores with the two instruments (PSI, and PPCI) on the five patient units. Although patient satisfaction and chart compliance total scores were generally high, the study found that patients on the units without computers were more satisfied with nursing care and had better chart documentation compliance than patients with computers in their rooms. Nevertheless, most patients were very positive when describing the technology's effect on their care in the room environment.

DISCUSSION

The implications of negative patient satisfaction and negative chart compliance on units with bedside computers are numerous. One must look at the placement of devices, number of functions available, the implementation process for bedside systems, nurses' attitudes and the overall goals of computerizing nursing functions at the bedside for patient care. If improvements in quality of patient care is the goal, this study indicates that either the computers were not placed properly, or implemented effectively. Simply placing the computer at the bedside may not bring quality improvement because the nurse may be in the room more. Perhaps by increasing technology, the relationship between the nurse and the patient is changed or decreased. Technology may interfere with simple human caring.

Spranzo [17] suggests that changing the work processes of the users to match the information flow activities in the setting would improve the quality of patient care. Simpson [18] indicates that improved change management strategies during systems planning is necessary for effectiveness. In addition, fixed terminals (wall or shelf mounted) in the patient room may not be the correct modality for documentation of patient care. Many acute care facilities are exploring mobile (hand held, pen based) technologies for health care providers. Patient centered or patient focused care encompasses the redesign of hospital resources and personnel around patient care, rather than around hospital departments [19] [20]. PCT in combination with patient centered care infrastructure modifications, may bring the changes necessary to improve the quality of patient care.

Further study must be conducted on PCT especially on nurses attitudes. In addition, research should be directed toward the unexplained finding that African-American chart scores were a significant predictor ($p = .0126$) of negative audit scores.

Finally, the computer-based patient record (CPR) is playing an ever increasing role in our health care environment [21]. If the capture, retrieval and processing of clinical data at the patient encounter is the objective of future information systems, one must review the findings of this study for policy changes toward that goal. In summary, the work processes, change management strategies, goals of computerization (quality/cost) and patient care

delivery systems should be reviewed in light of the findings of this study. Moreover, nursing administration should reexamine the intent and direction of information systems technology for medical/surgical units in acute care hospitals. Jacox and Pillar [22] warn us that technology alone does not mean improved patient care.

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